



Equity Mine – 25 Years of Closure

Cody Meints – Site Supervisor, Equity Mine

November 29, 2018

Mining History



Production Statistics

- Production from 1980 to 1993
- Silver 72.3 million oz
- Gold 498,000 oz
- Copper 189.6 million lbs
- 21,500 tonnes/day mined
- 9,000 tonnes/day milled
- Averaged 158 employees



Mine Plan



Milling



Milling



Decommissioning - 1994



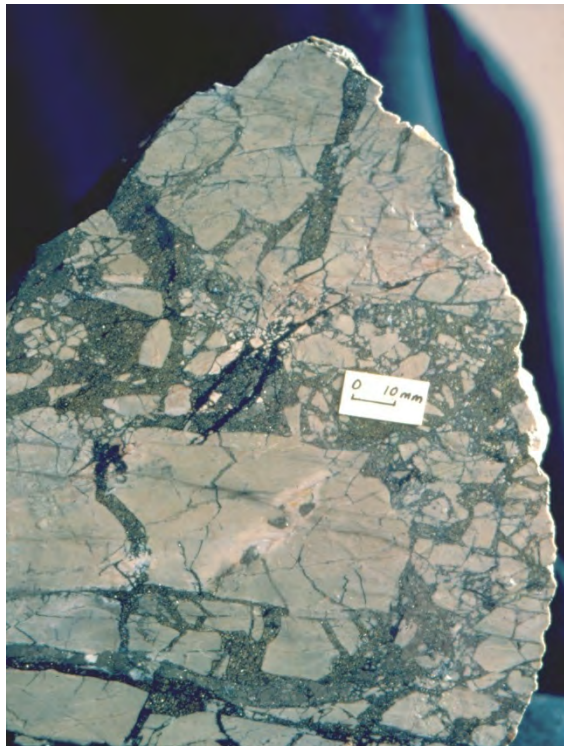
Plant Site – Before and After



Acid Rock Drainage



ARD Generation



Equity first learned that the waste rock and ore would oxidize and produce ARD in 1982 after a year and a half of construction and two years of production

Baseline Sampling

No grey zone

Hole	Depth (m)	Date	Neutralizing Potential	Paste pH	Max Potential Acidity	Net Neutralizing Potential	NPR
66	23-26	08/29/73	31.40	6.20	271.00	-239.60	0.12
72	52-56	08/29/73	24.50	8.10	292.00	-267.50	0.08
75	28-32	08/29/73	19.60	6.90	101.00	-81.40	0.19



Baseline Sampling

A total of three samples were collected prior to mining for ABA analysis

- Samples collected from drill core and only represented the ore deposit not the waste rock
- **No kinetic testing**, only static ABA tests

A lack of knowledge about ARD within the industry at the time allowed this statement from the environmental consultant in charge of the base line studies at Equity:

- “Drill core samples of ore were tested by BC Research to study the rock’s acid producing potential. These tests indicated that under acidic conditions the rock has the potential of producing acid water. **Because the rock will not be artificially acidified and the climate is not hot and humid, acid production from the dumps is not anticipated.**”

The company and government accepted this statement since it is what they wanted to hear. As a result no consideration was given at the design or construction stage to include any mitigation for the potential of ARD in the future.

Baseline Sampling



- Consultants assumed that the cold weather in Northern Canada would inhibit oxidation
- The opposite is true – the cold weather might initially slow the oxidation, but once oxidation begins the cooler ambient temperatures in the winter set up venting conditions that ‘pump’ oxygen through the waste rock dumps

Mine Plan



With no thought of ARD mitigation the mine plan was developed strictly to economically mine the deposit:

- Initial waste rock was used for the plantsite backfill, a tailings starter dam, and road construction
- The mining started with the Southern Tail pit as it had the highest metal values and could pay down the debt quicker
- The waste rock dumps were constructed close to the open pits, in an area that sloped down towards Bessemer Creek

ARD Sources



ARD
Storage
and
Treatment

#1 Dam
Seepage
20% volume
4% acidity

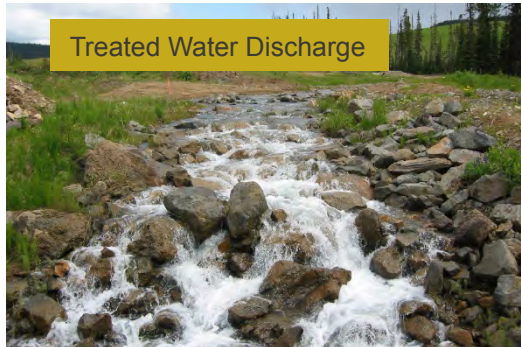


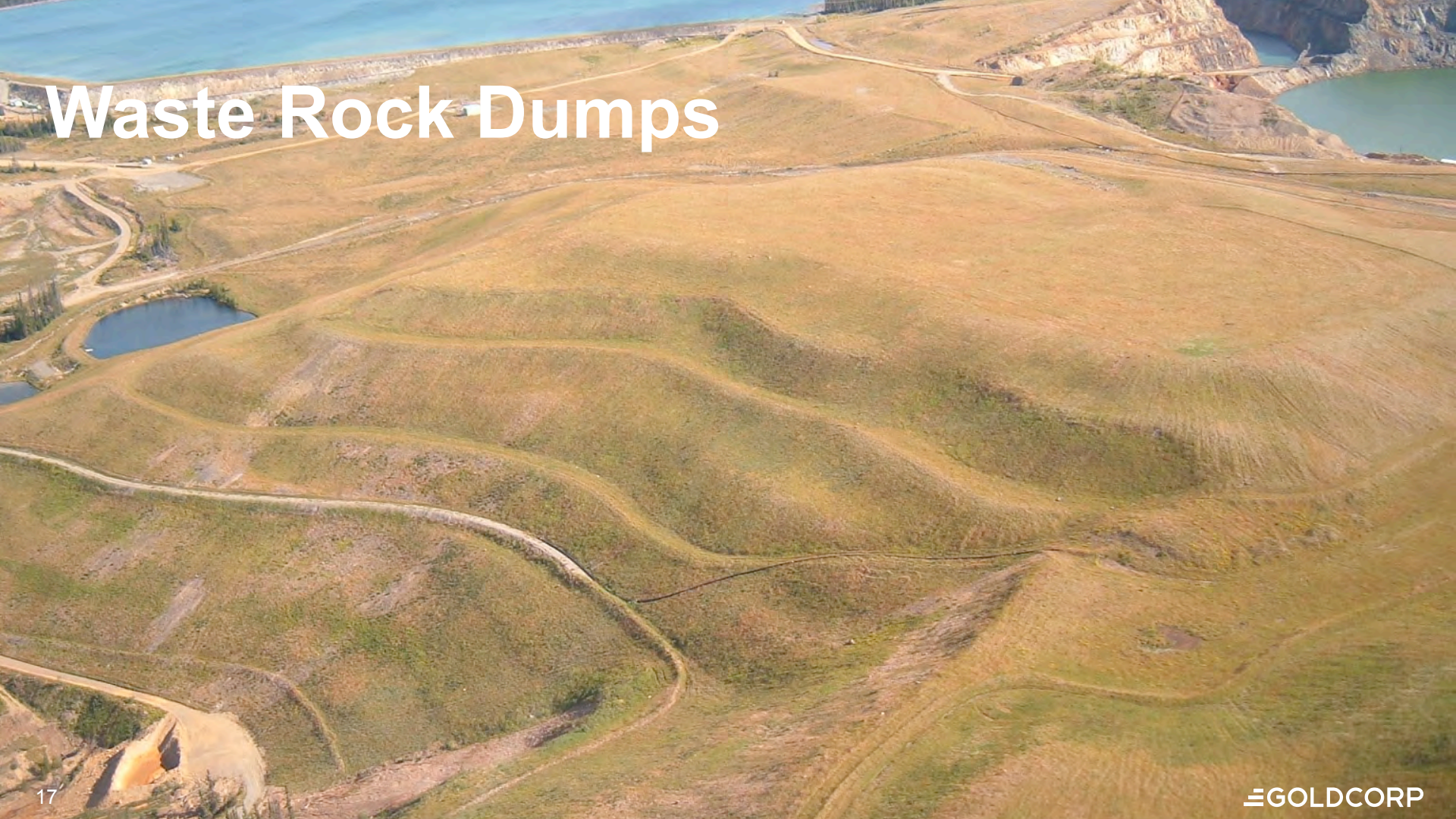
Waste Rock
Stockpiles
65% volume
94% acidity

Reclaimed
Plantsite
15% volume
2% acidity



ARD Cycle





Waste Rock Dumps

Waste Rock Dump Cover



Original waste dump cover was 1 metre of uncompacted till

- 40% infiltration

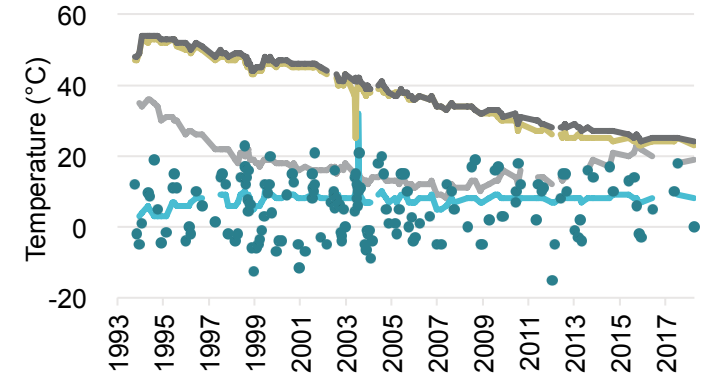
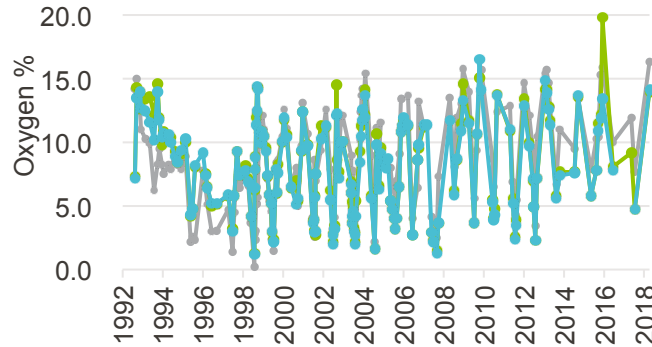
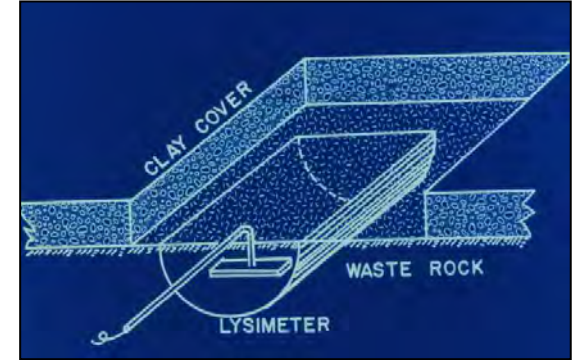
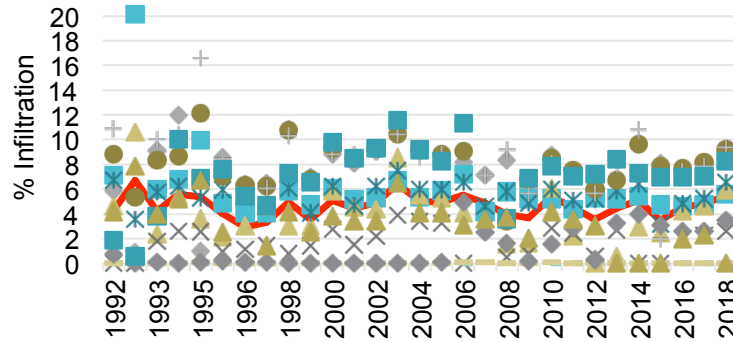
Final cover started in 1990 to reduce water infiltration

- 0.5 m compacted till
- 0.3 m uncompacted till
- expected 2 to 5% water infiltration & decreased oxygen infiltration

Waste Rock Dump Cover



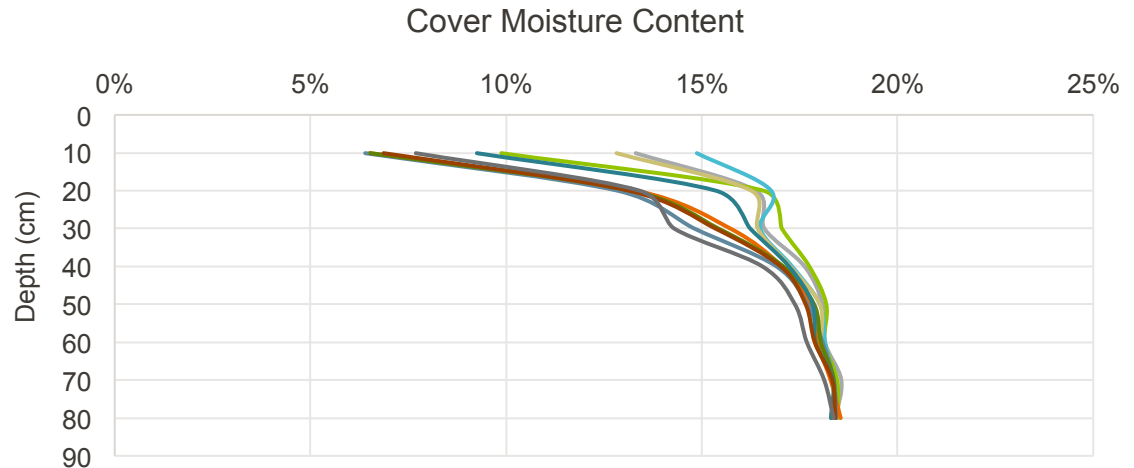
Waste Rock Dump Monitoring



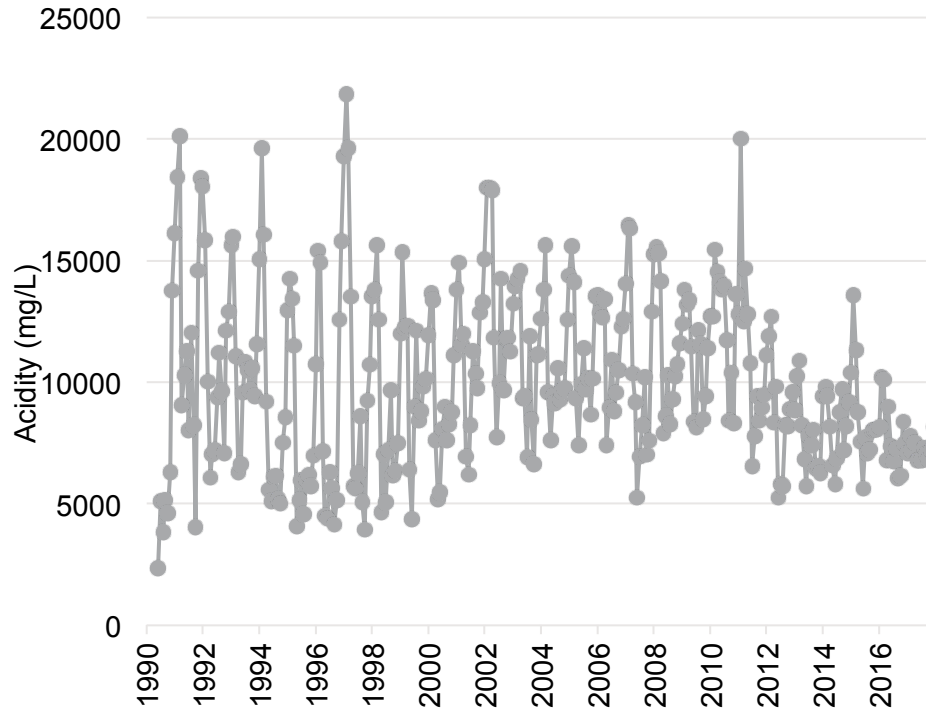
Cover Moisture Content



Neutron probe measures moisture content within the cover.



Main ARD Pond Acidity



Tailings Facility



Tailings Facility

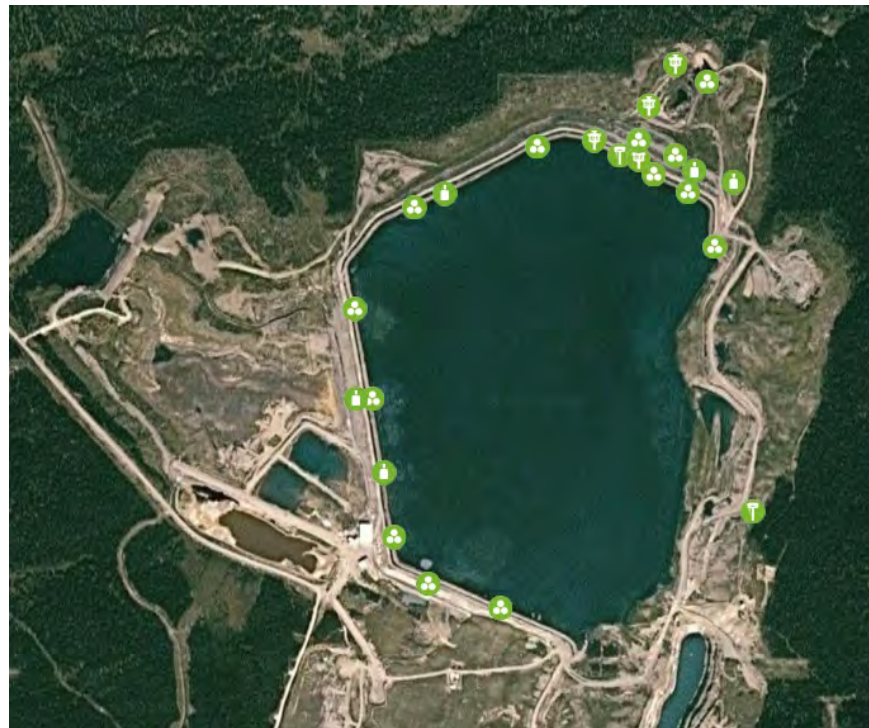


- 35 million tonnes PAG tailings in a 120 Ha pond
- Water cover 1.5 m to 8 m (5.6 Mm³)
- Decant/pump excess water to Diversion Pond or Main Zone pit for discharge
- Periodic lime slurry addition to raise pH
- Potential for reprocessing to remove Au, Ag, S
- Annual geotechnical review, daily inspection by staff, automated monitoring system

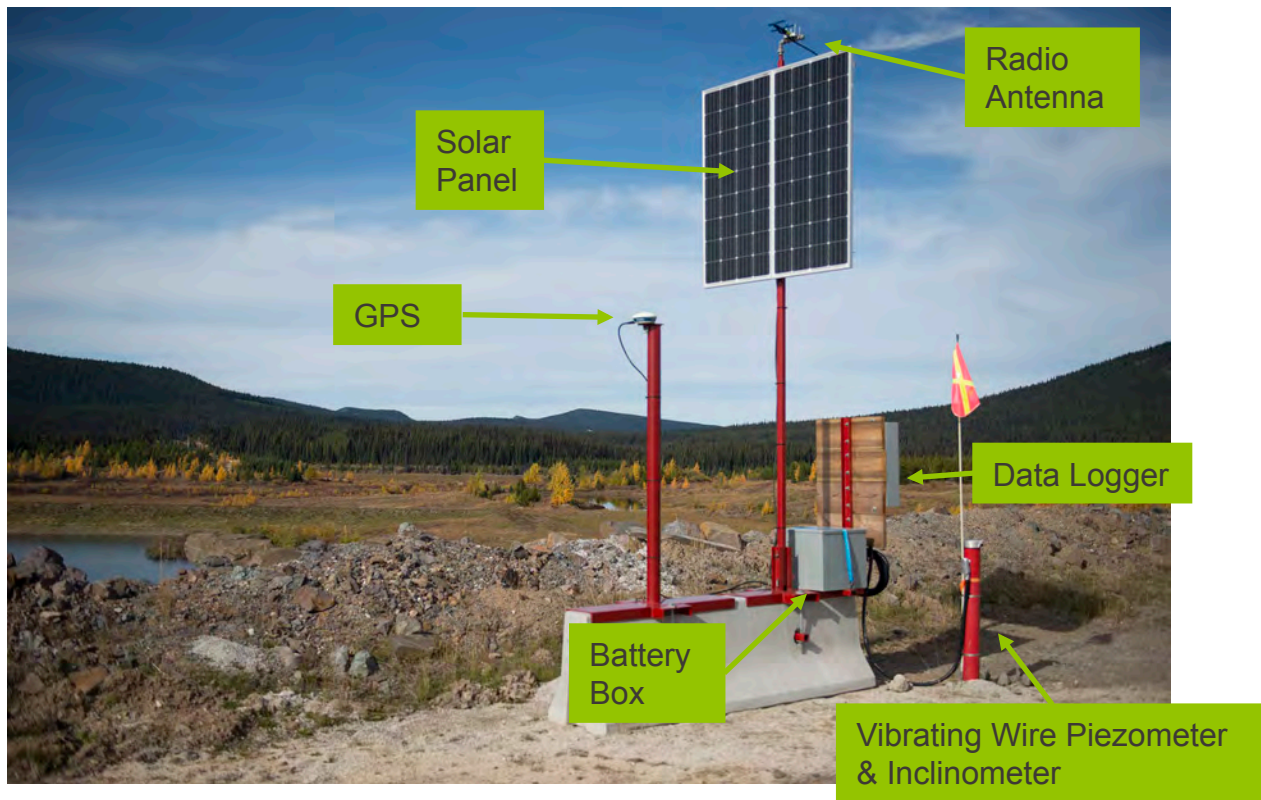
Tailings Dams Remote Monitoring

Instrumentation includes:

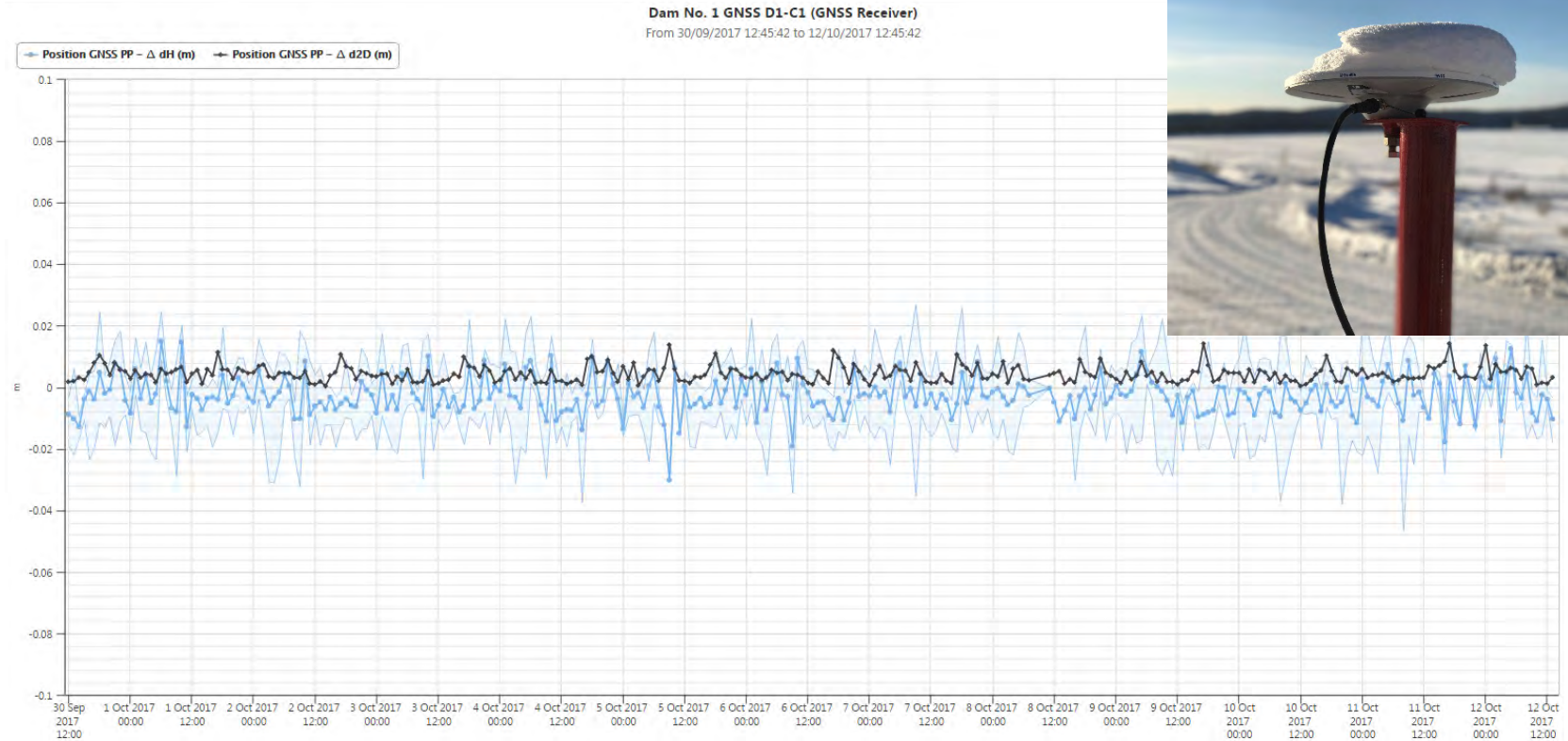
- 10 GNSS (GPS) receivers
- automatic total station (6 prisms)
- 18 piezometers
- 5 cameras
- 1 weather station
- 2 pond water level stations



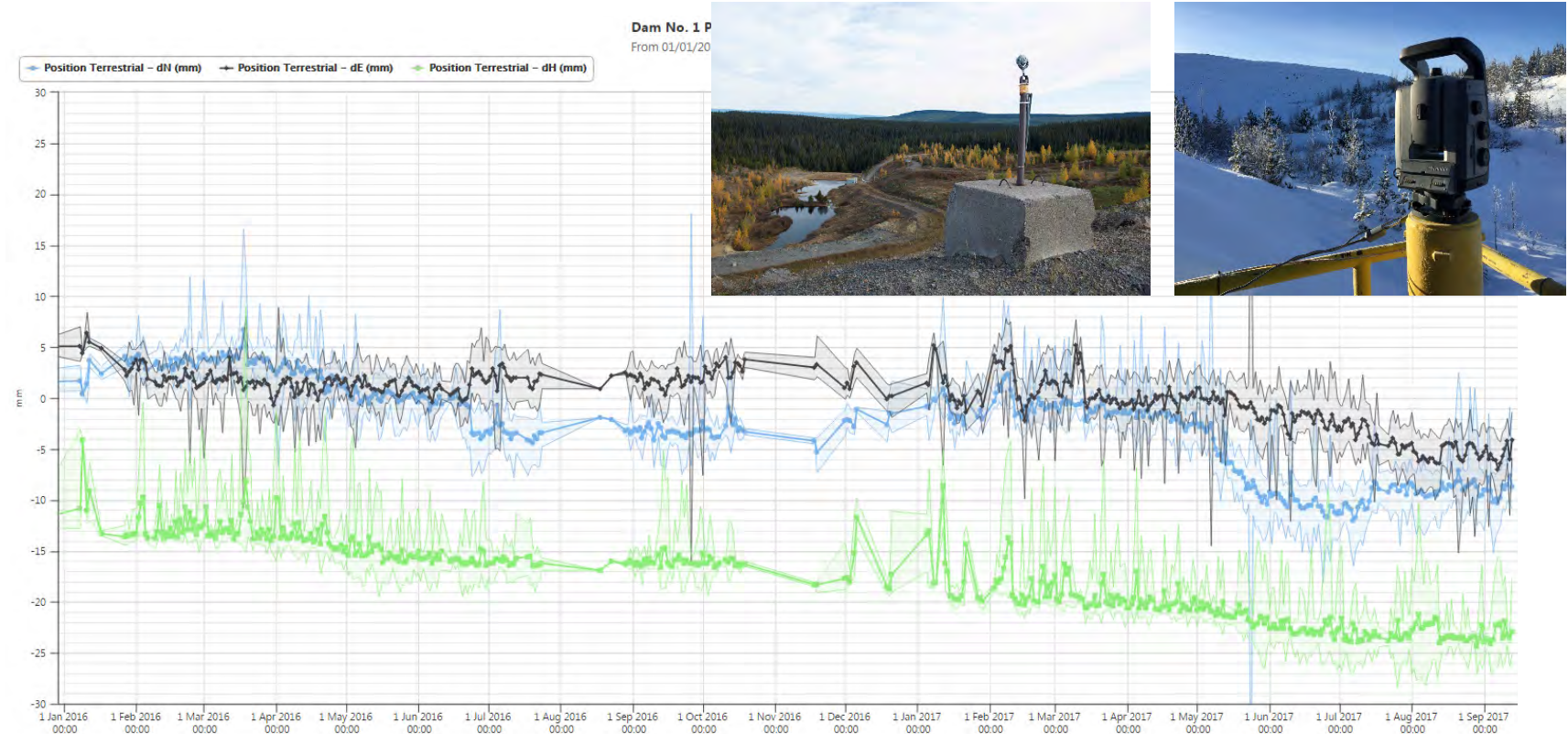
Tailings Dams Remote Monitoring



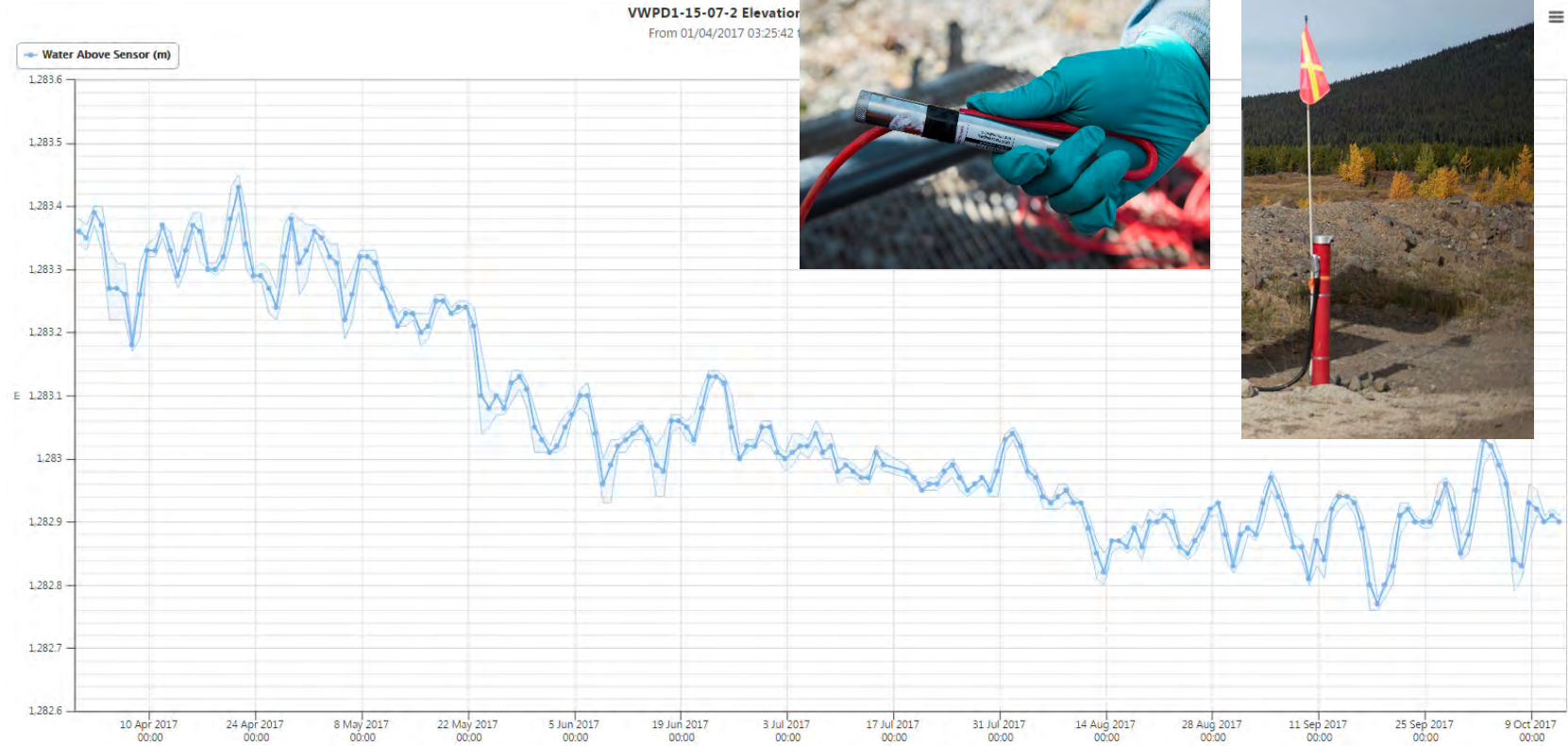
Remote Monitoring – GNSS



Remote Monitoring – Prisms



Remote Monitoring – Vibrating Wire Piezometers



Remote Monitoring – Camera Views

Dam #1 Pumphouse Camera 2018-04-10 13:42:18



Dam #2 Office Camera 2018-04-10 13:31:49



Diversion Dam Splitter Dike Camera 2018-04-04 18:53:20



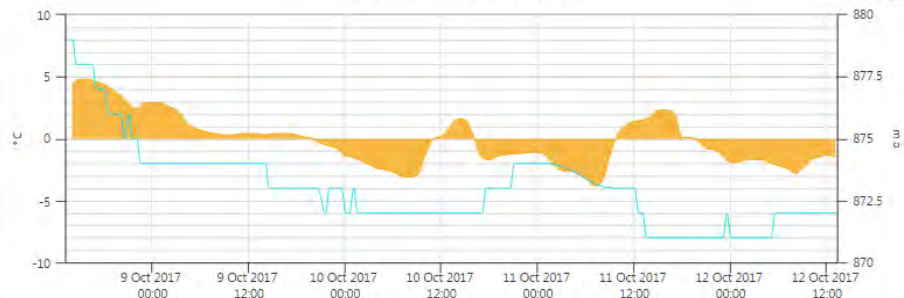
Remote Monitoring – Weather Station

Weather
Last 96 Hours

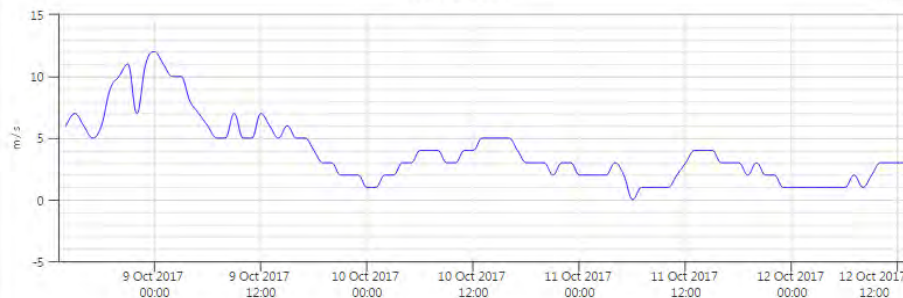
Start Live Update

Show controls

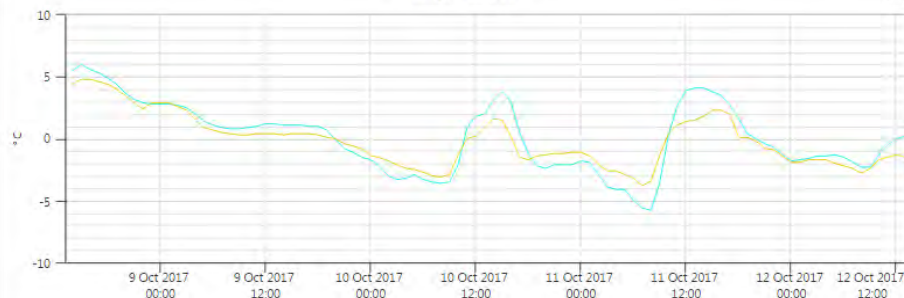
Air Temperature, Air Pressure



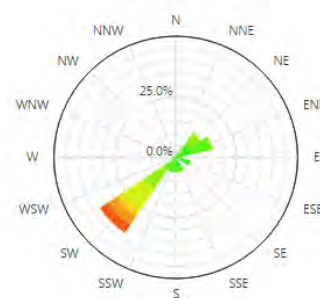
Wind Speed



Temperatures



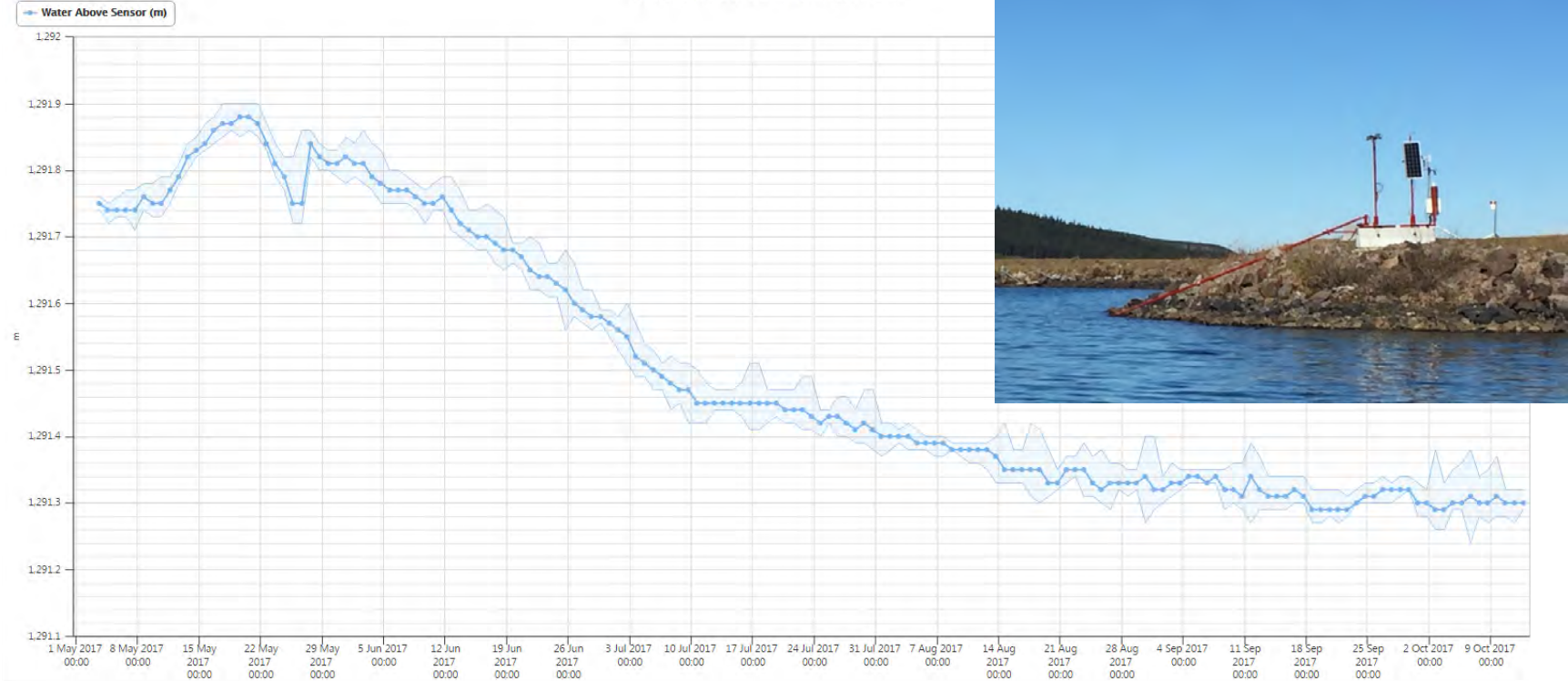
Wind



Remote Monitoring – Water Level Indicators

Dam No. 1 Pond Elevation (Water Level Sensor)

From 01/05/2017 12:45:42 to 12/10/2017 12:45:42



Tailings Dams Remote Monitoring – Alarms

Trimble 4D Control™

Project: Equity Silver Dam Monitoring (UTC -8) 04/04/2018 14:23:50 Cody Meints (Analyst) Sign Out

Home Sensors Terrain View Charting and Analysis Monitoring Framed Pages Administration

Select Alarm Definition

Pond Water Level (OK)

VWPD1-15-01 Yellow Alert (OK)

VWPD1-15-03A-1 Yellow Alert (OK)

VWPD1-15-03A-2 Yellow Alert (OK)

VWPD1-15-05 Yellow Alert (OK)

VWPD1-15-06 Yellow Alert (OK)

VWPD1-15-07-1 Yellow Alert (OK)

VWPD1-15-07-2 Yellow Alert (OK)

VWPD1-15-08 Yellow Alert (OK)

VWPD2-15-01 Yellow Alert (OK)

VWPD2-15-02 Yellow Alert (OK)

VWPD2-15-03 Yellow Alert (OK)

VWPD2-15-04 Yellow Alert (OK)

VWPD2-15-01-1 Yellow Alert (OK)

VWPD2-15-01-2 Yellow Alert (OK)

View Alarm (Alarm Enabled) - OK

Name

Pond Water Level

Evaluation Frequency

1 Hour

Condition Merge Order

And before Or

Revision

0

Evaluation Window Enabled

No

Notification granularity

Alarm status changed

Owner

System Administrator

Last Evaluated

04/04/2018 13:47:00

Require Acknowledge

Yes

Description

Alarm to determine if pond water elevation has changed dramatically.

Escalation Interval

10 Minutes

Last Changed

Never

Customize messages

No

Create Copy Notification Recipients Batch Files Webcams View Charts History Refresh

Conditions

	Merge Operand	Data Type	Sensor Link Mode	Evaluation	Condition Type	Reference Date	Filter	Attention Threshold	Warning Threshold	Alarm Threshold	No Data Threshold	
1	Where	Length	Specific Sensor(s)	Avg of (3)	Relative Measurement (Δ)	7 Days	Disabled	$ \Delta \text{Length} \geq 1.000 \text{ m}$	$ \Delta \text{Length} \geq 1.000 \text{ m}$	$ \Delta \text{Length} \geq 1.000 \text{ m}$	1 Day	i
				Dam No. 1 Pond Elevation (Water Above Sensor)		1,291.734 m (04/04/2018 13:46:20)	1,291.748 m (28/03/2018 13:46:20)	$ -0.014 \geq 1.000$	$ -0.014 \geq 1.000$	$ -0.014 \geq 1.000$	0 Days < 1 Day	
2	And	Length	Specific Sensor(s)	Avg of (3)	Relative Measurement (Δ)	7 Days	Disabled	$ \Delta \text{Length} \geq 1.000 \text{ m}$	$ \Delta \text{Length} \geq 1.000 \text{ m}$	$ \Delta \text{Length} \geq 1.000 \text{ m}$	1 Day	i
				Dam No. 2 Pond Elevation (Water Above Sensor)		1,291.785 m (04/04/2018 12:30:00)	1,291.766 m (28/03/2018 12:30:00)	$ 0.019 \geq 1.000$	$ 0.019 \geq 1.000$	$ 0.019 \geq 1.000$	0 Days < 1 Day	

Export To PDF

ARD Treatment



High Density Sludge (HDS) Treatment Plant



- 2,500 USG/min normal operating flow rate
- Capable of 5,000 USG/min emergency flow rate in “low density mode”
- 2 high volume paste slakers
- Lime addition to pH 8.5 for metals removal
- 25 m diameter clarifier, flocculant addition
- Sludge recycle to create high density sludge which quickly settles
- Treated water and sludge to Main Zone Pit



ARD Treatment and Statistics



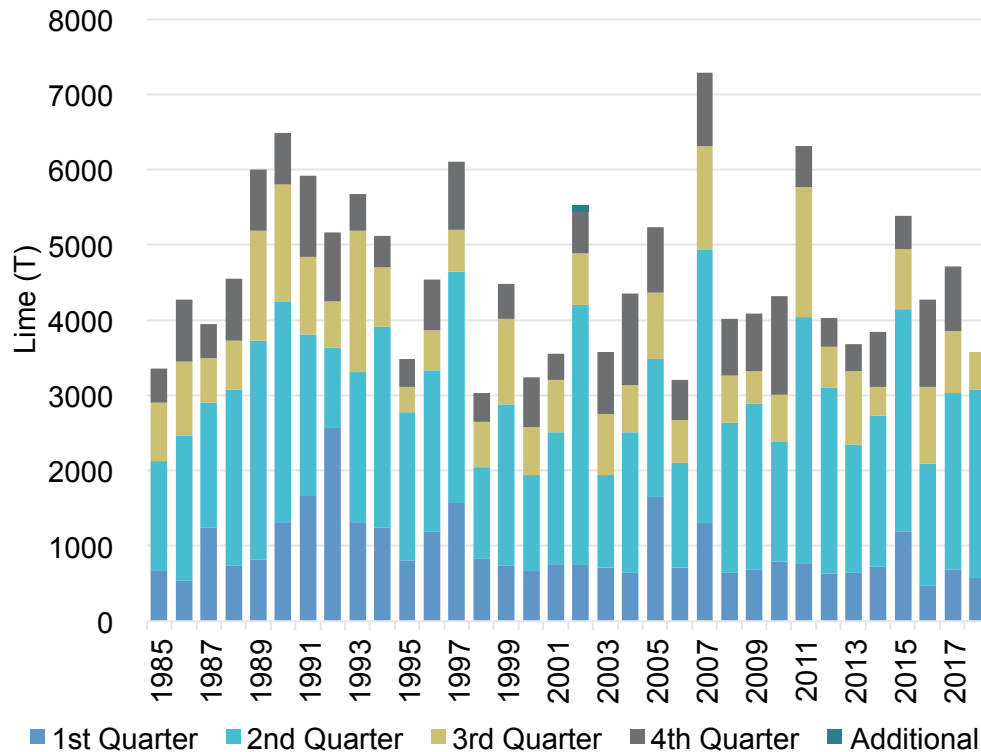
1985 to 2017 Averages:

- Treated ARD volume: 970,000 m³
- Lime consumption: 4628T



	pH	Acidity	Copper	Iron	Zinc
	(pH unit)	(mg/L CaCO ₃ eq)	(mg/L)	(mg/L)	(mg/L)
ARD Avg	2.6	7585	54	817	117
ARD Min	2.0	2290	17	176	39
ARD Max	3.2	17200	120	1941	240
Treated Avg	8.6	0	0.0096	0.104	0.017

Lime use



- 700 T lime storage
- 4628 T annual usage
- 970,000 m³ ARD treated
- Average acidity 7585 mg/L

Hydrology



Consequences of Getting the Hydrology Wrong

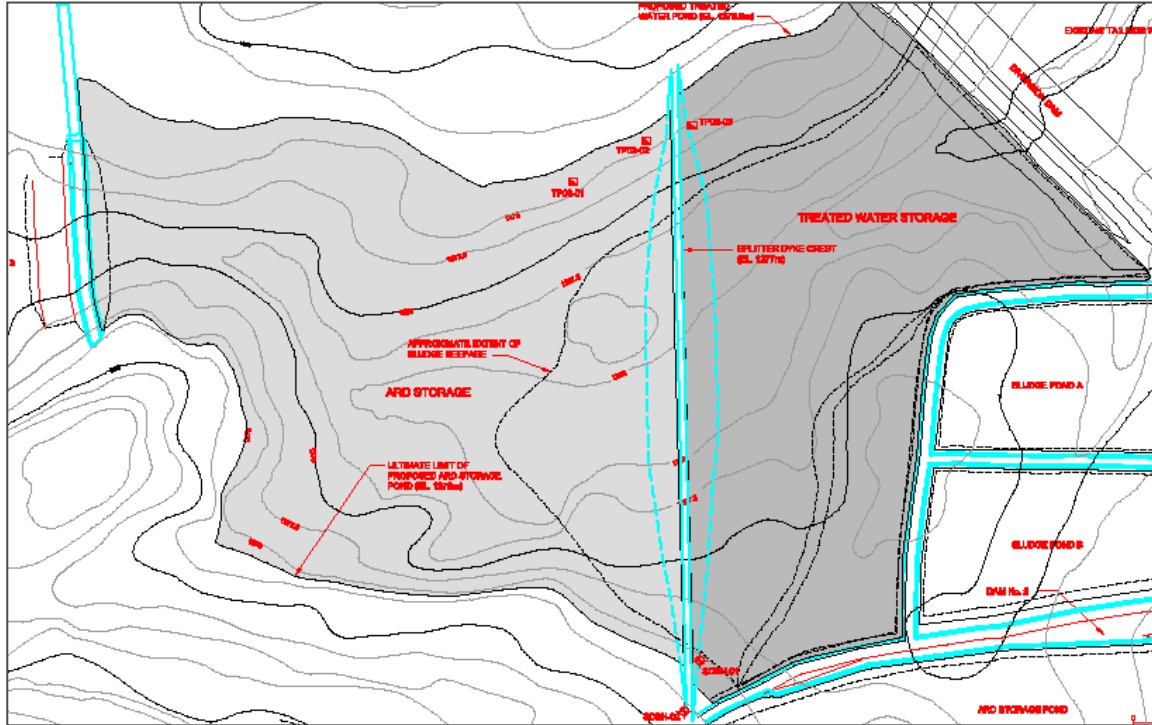
- 1997 – Diverted low strength ARD to environment
 - Insufficient ARD pumping capacity at Main Pond
 - Decreased ARD collection catchment, but only minor pumping improvements – see if ARD could be decreased
- 2002 – Diverted low strength ARD, under-treated ARD
 - Insufficient ARD pumping capacity at Main Pond
 - Insufficient treatment capacity
 - Insufficient ARD storage capacity
- Extensive upgrades to the ARD collection and treatment system completed
 - New pumphouse and pipelines for Main Pond (2002)
 - Increased ARD storage and treated water capacity (2002)
 - New HDS treatment plant (2003)
 - Significant increase in ARD storage (2003 - 2008)

Main Pond Pumphouse (Upper)

- Three 250 HP pumps each capable of 2,000 USG/min
- Two 16" pipelines to Storage Pond with connection to HDS plant
- Can be operated using with emergency backup power
- 10,000 USG/min pumping capacity from Main Pond with old and new pumphouses



Emergency ARD Storage



- Capacity of 700,000 m³
- Can store approximately three quarters of annual year
- Extra storage for large flow events or significant breakdown in treatment plant

Emergency ARD Storage – Sludge Removal

Sludge removal to MZP

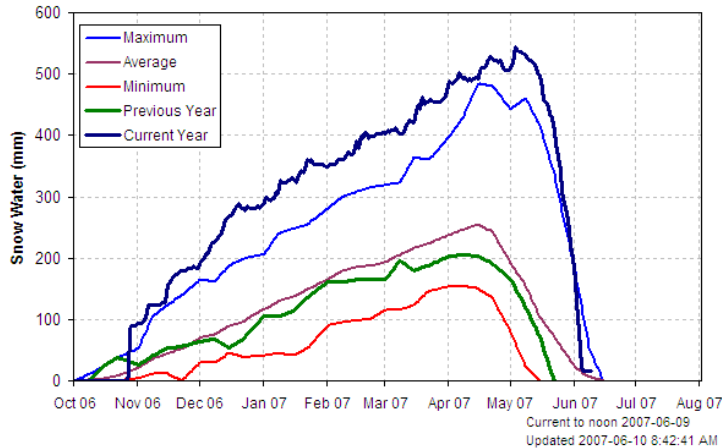
- Thick sludge could be hauled
- Wetter sludge could be pumped



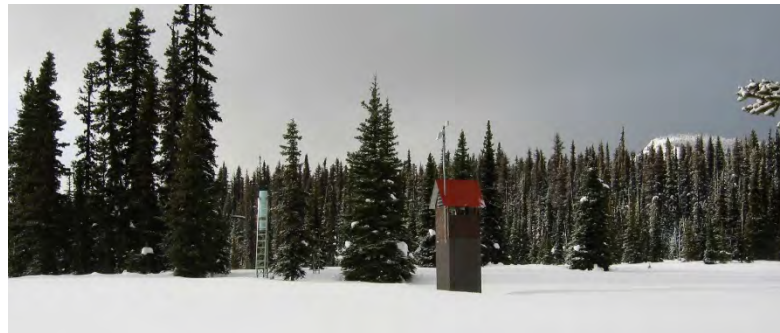
HDS Plant Construction



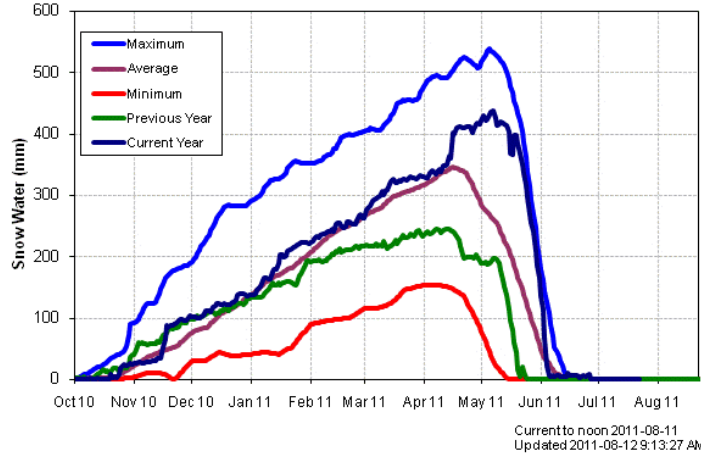
2007 Freshet – Highest on record



- 2007 freshet started with 100 cm snowfall in October 2006
- Highest snow pack on record for site and region
- Rapid melt after mid May
- Regional flooding
- No issues at Equity site



2011 Freshet



- Average Snow pack until mid April
- Significant precipitation in April and May (rain and snow)
- Regional flooding
- Emergency ARD Pond used for 20,000 m³ of ARD
- 161,000 m³ collected from Main Pond during peak week



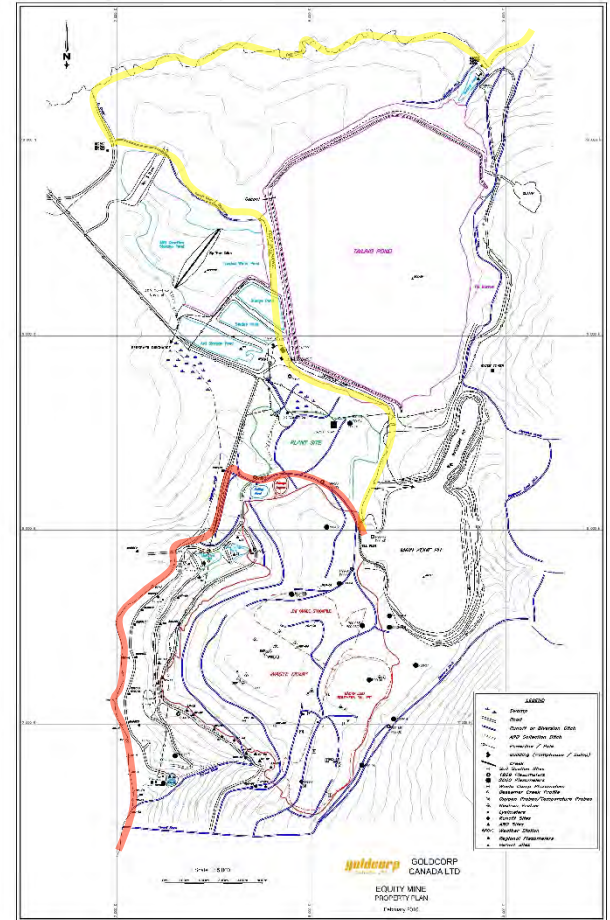
Environmental Monitoring



A photograph showing a dam structure with water flowing over it. The dam is constructed with a series of stone or concrete blocks, creating a stepped appearance. The water is white and turbulent as it flows down the face of the dam. The surrounding area is a dense forest of tall evergreen trees, and the sky is overcast.



- 2002 to 2017 average
2,190,000 m³ water
discharged off site
- 2/3 discharged to Buck Creek
- 1/3 discharged to Foxy Creek
- 3:1 Dilution Required by MoE
Permit



Environmental Effects Monitoring

Every 4 years as per MoE permit PE-4475

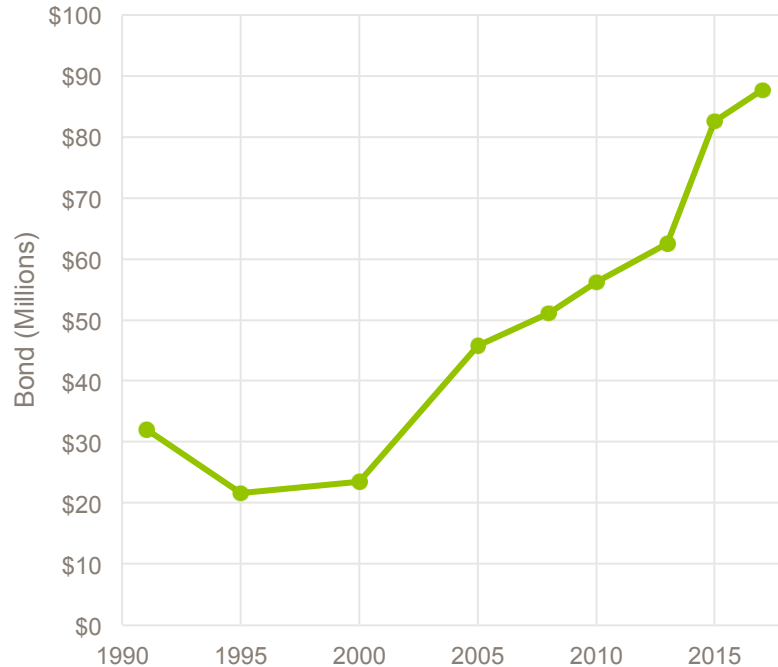
- Environmental health of Foxy Creek, Buck Creek, and Goosly Lake
- Fish, Benthic Invertebrates, Periphyton, Sediment
- Ceriodaphnia and rainbow trout bioassays



Security Bond

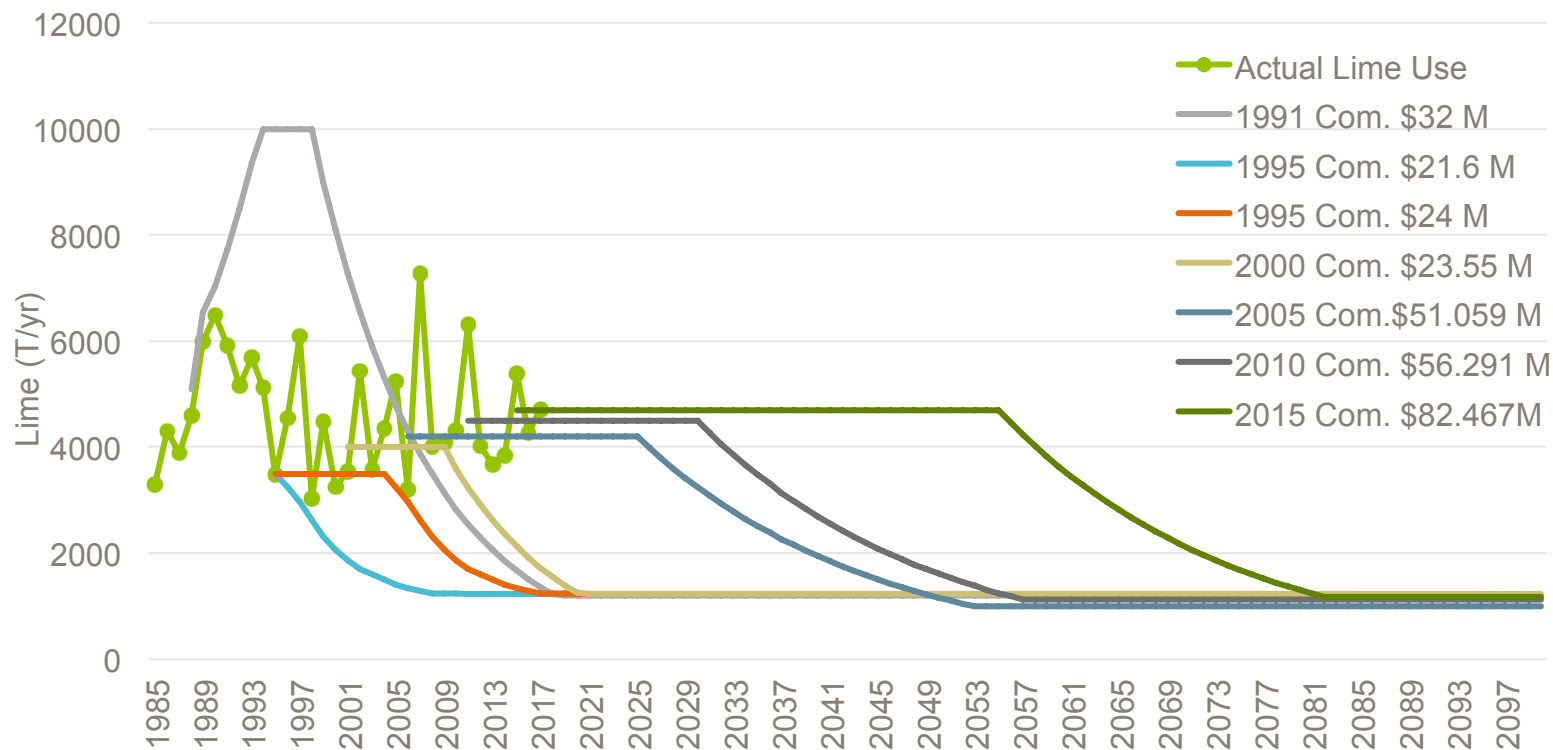


Security Bond Review



- Long term security bond held as letter of credit - currently \$87.722 M
- Components of the security calculation are fixed costs, variable costs, lime costs, periodic costs .
- Triggers used between five year bond review intervals to minimize risk of under-funding (lime unit cost, lime use, power)
- Uncertainty lies mainly in lime consumption, but also in unit costs and interest rates
- MEMPR, MoE, NRCan, Local Landowner, Goldcorp attend meetings (First Nations, DoH, EC invited)

Security Bond Review



Bond Components

Fixed Costs	Variable Costs	Periodic Costs
Salaries (op/r&m)	Power	Major equipment repair
Benefits	Supplies	Cover repairs (major and minor)
Services Purchased	Pumps & piping	EEM studies
Road Maintenance		Major infrastructure maintenance
Equipment maintenance		Geotech Reviews



Additional Information

Knowledge Sharing



Wildlife



360° Virtual Tour by VRify



360° Virtual Tour by VRify



www.goldcorp.com > Portfolio > Closed Sites > Equity



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